SEQUENCE LISTING

<110> Napier, Johnathan A.
Sayanova, Olga
Lazarus, Colin M.
Qi, Baoxiu
Heinz, Ernst
Zank, Thorsten
Zahringer, Ulrich

<120> Novel method for the production of polyunsaturated fatty acids

<130> 13478-00001-US

<140> US 10/539,891
<141> 2005-06-17

<150> PCT/EP2003/014054
<151> 2003-12-11

<150> GB 0229578.0
<151> 2002-12-19

<150> GB 0316989.3
<151> 2003-07-21

<160> 16

<170> PatentIn version 3.4

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tat gat gtg tct gcc tgg gtc aat ttc cac cct ggt ggt gcg gaa att   96
Tyr Asp Val Ser Ala Trp Val Asn Phe His Pro Gly Gly Ala Glu Ile
             20                  25                  30

ata gag aat tac caa gga agg gat gcc act gat gcc ttc atg gtt atg   144
Ile Glu Asn Tyr Gln Gly Arg Asp Ala Thr Asp Ala Phe Met Val Met
         35                  40                  45

cac tct caa gaa gcc ttc gac aag ctc aag cgc atg ccc aaa atc aat   192
His Ser Gln Glu Ala Phe Asp Lys Leu Lys Arg Met Pro Lys Ile Asn
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ccc agt tct gag ttg cca ccc cag gct gca gtg aat gaa gct caa gag   240
Pro Ser Ser Glu Leu Pro Pro Gln Ala Ala Val Asn Glu Ala Gln Glu
 65                  70                  75                  80

gat ttc cgg aag ctc cga gaa gag ttg atc gca act ggc atg ttt gat   288
Asp Phe Arg Lys Leu Arg Glu Glu Leu Ile Ala Thr Gly Met Phe Asp
                 85                  90                  95

gcc tcc ccc ctc tgg tac tca tac aaa atc agc acc aca ctg ggc ctt   336
Ala Ser Pro Leu Trp Tyr Ser Tyr Lys Ile Ser Thr Thr Leu Gly Leu
            100                 105                 110

gga gtg ctg ggt tat ttc ctg atg gtt cag tat cag atg tat ttc att   384
Gly Val Leu Gly Tyr Phe Leu Met Val Gln Tyr Gln Met Tyr Phe Ile
        115                 120                 125

ggg gca gtg ttg ctt ggg atg cac tat caa cag atg ggc tgg ctt tct   432
Gly Ala Val Leu Leu Gly Met His Tyr Gln Gln Met Gly Trp Leu Ser
    130                 135                 140

cat gac att tgc cac cac cag act ttc aag aac cgg aac tgg aac aac   480
His Asp Ile Cys His His Gln Thr Phe Lys Asn Arg Asn Trp Asn Asn
145                 150                 155                 160

ctc gtg gga ctg gta ttt ggc aat ggt ctg caa ggt ttt tcc gtg aca   528
Leu Val Gly Leu Val Phe Gly Asn Gly Leu Gln Gly Phe Ser Val Thr
                165                 170                 175

tgc tgg aag gac aga cac aat gca cat cat tcg gca acc aat gtt caa   576
Cys Trp Lys Asp Arg His Asn Ala His His Ser Ala Thr Asn Val Gln
            180                 185                 190

ggg cac gac cct gat att gac aac ctc ccc ctc tta gcc tgg tct gag   624
Gly His Asp Pro Asp Ile Asp Asn Leu Pro Leu Leu Ala Trp Ser Glu
        195                 200                 205

gat gac gtc aca cgg gcg tca ccg att tcc cgc aag ctc att cag ttc   672
Asp Asp Val Thr Arg Ala Ser Pro Ile Ser Arg Lys Leu Ile Gln Phe
    210                 215                 220

cag cag tat tat ttc ttg gtc atc tgt atc ttg ttg cgg ttc att tgg   720
Gln Gln Tyr Tyr Phe Leu Val Ile Cys Ile Leu Leu Arg Phe Ile Trp
225                 230                 235                 240

tgt ttc cag agc gtg ttg acc gtg cgc agt ctg aag gac aga gat aac   768
Cys Phe Gln Ser Val Leu Thr Val Arg Ser Leu Lys Asp Arg Asp Asn
                245                 250                 255

caa ttc tat cgc tct cag tat aag aag gag gcc att ggc ctc gcc ctg   816
Gln Phe Tyr Arg Ser Gln Tyr Lys Lys Glu Ala Ile Gly Leu Ala Leu
            260                 265                 270

cat tgg aca ttg aag gcc ctg ttc cac tta ttc ttt atg ccc agc atc   864
His Trp Thr Leu Lys Ala Leu Phe His Leu Phe Phe Met Pro Ser Ile
        275                 280                 285

ctc aca tcg ctg ttg gta ttt ttc gtt tcg gag ctg gtt ggc ggc ttc   912
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Leu Thr Ser Leu Leu Val Phe Phe Val Ser Glu Leu Val Gly Gly Phe
    290                 295                 300

ggc att gcg atc gtg gtg ttc atg aac cac tac cca ctg gag aag atc   960
Gly Ile Ala Ile Val Val Phe Met Asn His Tyr Pro Leu Glu Lys Ile
305                 310                 315                 320

ggg gac tcg gtc tgg gat ggc cat gga ttc tcg gtt ggc cag atc cat   1008
Gly Asp Ser Val Trp Asp Gly His Gly Phe Ser Val Gly Gln Ile His
                325                 330                 335

gag acc atg aac att cgg cga ggg att atc aca gat tgg ttt ttc gga   1056
Glu Thr Met Asn Ile Arg Arg Gly Ile Ile Thr Asp Trp Phe Phe Gly
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ggc ttg aac tac cag atc gag cac cat ttg tgg ccg acc ctc cct cgc   1104
Gly Leu Asn Tyr Gln Ile Glu His His Leu Trp Pro Thr Leu Pro Arg
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cac aac ctg aca gcg gtt agc tac cag gtg gaa cag ctg tgc cag aag   1152
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cac aac ctg ccg tat cgg aac ccg ctg ccc cat gaa ggg ttg gtc atc   1200
His Asn Leu Pro Tyr Arg Asn Pro Leu Pro His Glu Gly Leu Val Ile
385                 390                 395                 400

ctg ctg cgc tat ctg gcg gtg ttc gcc cgg atg gcg gag aag caa ccc   1248
Leu Leu Arg Tyr Leu Ala Val Phe Ala Arg Met Ala Glu Lys Gln Pro
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Ile Glu Asn Tyr Gln Gly Arg Asp Ala Thr Asp Ala Phe Met Val Met
         35                  40                  45

His Ser Gln Glu Ala Phe Asp Lys Leu Lys Arg Met Pro Lys Ile Asn
     50                  55                  60

Pro Ser Ser Glu Leu Pro Pro Gln Ala Ala Val Asn Glu Ala Gln Glu
 65                  70                  75                  80
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Asp Phe Arg Lys Leu Arg Glu Glu Leu Ile Ala Thr Gly Met Phe Asp
                 85                  90                  95

Ala Ser Pro Leu Trp Tyr Ser Tyr Lys Ile Ser Thr Thr Leu Gly Leu
            100                 105                 110

Gly Val Leu Gly Tyr Phe Leu Met Val Gln Tyr Gln Met Tyr Phe Ile
        115                 120                 125

Gly Ala Val Leu Leu Gly Met His Tyr Gln Gln Met Gly Trp Leu Ser
    130                 135                 140

His Asp Ile Cys His His Gln Thr Phe Lys Asn Arg Asn Trp Asn Asn
145                 150                 155                 160

Leu Val Gly Leu Val Phe Gly Asn Gly Leu Gln Gly Phe Ser Val Thr
                165                 170                 175

Cys Trp Lys Asp Arg His Asn Ala His His Ser Ala Thr Asn Val Gln
            180                 185                 190

Gly His Asp Pro Asp Ile Asp Asn Leu Pro Leu Leu Ala Trp Ser Glu
        195                 200                 205

Asp Asp Val Thr Arg Ala Ser Pro Ile Ser Arg Lys Leu Ile Gln Phe
    210                 215                 220

Gln Gln Tyr Tyr Phe Leu Val Ile Cys Ile Leu Leu Arg Phe Ile Trp
225                 230                 235                 240

Cys Phe Gln Ser Val Leu Thr Val Arg Ser Leu Lys Asp Arg Asp Asn
                245                 250                 255

Gln Phe Tyr Arg Ser Gln Tyr Lys Lys Glu Ala Ile Gly Leu Ala Leu
            260                 265                 270

His Trp Thr Leu Lys Ala Leu Phe His Leu Phe Phe Met Pro Ser Ile
        275                 280                 285

Leu Thr Ser Leu Leu Val Phe Phe Val Ser Glu Leu Val Gly Gly Phe
    290                 295                 300

Gly Ile Ala Ile Val Val Phe Met Asn His Tyr Pro Leu Glu Lys Ile
305                 310                 315                 320

Gly Asp Ser Val Trp Asp Gly His Gly Phe Ser Val Gly Gln Ile His
                325                 330                 335

Glu Thr Met Asn Ile Arg Arg Gly Ile Ile Thr Asp Trp Phe Phe Gly
            340                 345                 350

Gly Leu Asn Tyr Gln Ile Glu His His Leu Trp Pro Thr Leu Pro Arg
        355                 360                 365

His Asn Leu Thr Ala Val Ser Tyr Gln Val Glu Gln Leu Cys Gln Lys
    370                 375                 380
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His Asn Leu Pro Tyr Arg Asn Pro Leu Pro His Glu Gly Leu Val Ile
385                 390                 395                 400

Leu Leu Arg Tyr Leu Ala Val Phe Ala Arg Met Ala Glu Lys Gln Pro
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gac ccg gaa atc ctc att ggc acc ttc tcg tac ttg cta ctc aaa ccg   96
Asp Pro Glu Ile Leu Ile Gly Thr Phe Ser Tyr Leu Leu Leu Lys Pro
             20                  25                  30

ctg ctc cgc aat tcc ggg ctg gtg gat gag aag aag ggc gca tac agg   144
Leu Leu Arg Asn Ser Gly Leu Val Asp Glu Lys Lys Gly Ala Tyr Arg
         35                  40                  45

acg tcc atg atc tgg tac aac gtt ctg ctg gcg ctc ttc tct gcg ctg   192
Thr Ser Met Ile Trp Tyr Asn Val Leu Leu Ala Leu Phe Ser Ala Leu
     50                  55                  60

agc ttc tac gtg acg gcg acc gcc ctc ggc tgg gac tat ggt acg ggc   240
Ser Phe Tyr Val Thr Ala Thr Ala Leu Gly Trp Asp Tyr Gly Thr Gly
 65                  70                  75                  80

gcg tgg ctg cgc agg caa acc ggc gac aca ccg cag ccg ctc ttc cag   288
Ala Trp Leu Arg Arg Gln Thr Gly Asp Thr Pro Gln Pro Leu Phe Gln
                 85                  90                  95

tgc ccg tcc ccg gtt tgg gac tcg aag ctc ttc aca tgg acc gcc aag   336
Cys Pro Ser Pro Val Trp Asp Ser Lys Leu Phe Thr Trp Thr Ala Lys
            100                 105                 110

gca ttc tat tac tcc aag tac gtg gag tac ctc gac acg gcc tgg ctg   384
Ala Phe Tyr Tyr Ser Lys Tyr Val Glu Tyr Leu Asp Thr Ala Trp Leu
        115                 120                 125

agg gtc tcc ttt ctc cag gcc ttc cac cac ttt ggc gcg ccg tgg gat   432
Arg Val Ser Phe Leu Gln Ala Phe His His Phe Gly Ala Pro Trp Asp
    130                 135                 140
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gtg tac ctc ggc att cgg ctg cac aac gag ggc gta tgg atc ttc atg   480
Val Tyr Leu Gly Ile Arg Leu His Asn Glu Gly Val Trp Ile Phe Met
145                 150                 155                 160

ttt ttc aac tcg ttc att cac acc atc atg tac acc tac tac ggc ctc   528
Phe Phe Asn Ser Phe Ile His Thr Ile Met Tyr Thr Tyr Tyr Gly Leu
                165                 170                 175

acc gcc gcc ggg tat aag ttc aag gcc aag ccg ctc atc acc gcg atg   576
Thr Ala Ala Gly Tyr Lys Phe Lys Ala Lys Pro Leu Ile Thr Ala Met
            180                 185                 190

cag atc tgc cag ttc gtg ggc ggc ttc ctg ttg gtc tgg gac tac atc   624
Gln Ile Cys Gln Phe Val Gly Gly Phe Leu Leu Val Trp Asp Tyr Ile
        195                 200                 205

aac gtc ccc tgc ttc aac tcg gac aaa ggg aag ttg ttc agc tgg gct   672
Asn Val Pro Cys Phe Asn Ser Asp Lys Gly Lys Leu Phe Ser Trp Ala
    210                 215                 220

ttc aac tat gca tac gtc ggc tcg gtc ttc ttg ctc ttc tgc cac ttt   720
Phe Asn Tyr Ala Tyr Val Gly Ser Val Phe Leu Leu Phe Cys His Phe
225                 230                 235                 240

ttc tac cag gac aac ttg gca acg aag aaa tcg gcc aag gcg ggc aag   768
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<213> Isochrysis galbana

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Leu Leu Arg Asn Ser Gly Leu Val Asp Glu Lys Lys Gly Ala Tyr Arg
         35                  40                  45

Thr Ser Met Ile Trp Tyr Asn Val Leu Leu Ala Leu Phe Ser Ala Leu
     50                  55                  60

Ser Phe Tyr Val Thr Ala Thr Ala Leu Gly Trp Asp Tyr Gly Thr Gly
 65                  70                  75                  80

Ala Trp Leu Arg Arg Gln Thr Gly Asp Thr Pro Gln Pro Leu Phe Gln
                 85                  90                  95

Cys Pro Ser Pro Val Trp Asp Ser Lys Leu Phe Thr Trp Thr Ala Lys
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            100                 105                 110

Ala Phe Tyr Tyr Ser Lys Tyr Val Glu Tyr Leu Asp Thr Ala Trp Leu
        115                 120                 125

Arg Val Ser Phe Leu Gln Ala Phe His His Phe Gly Ala Pro Trp Asp
    130                 135                 140

Val Tyr Leu Gly Ile Arg Leu His Asn Glu Gly Val Trp Ile Phe Met
145                 150                 155                 160

Phe Phe Asn Ser Phe Ile His Thr Ile Met Tyr Thr Tyr Tyr Gly Leu
                165                 170                 175

Thr Ala Ala Gly Tyr Lys Phe Lys Ala Lys Pro Leu Ile Thr Ala Met
            180                 185                 190

Gln Ile Cys Gln Phe Val Gly Gly Phe Leu Leu Val Trp Asp Tyr Ile
        195                 200                 205

Asn Val Pro Cys Phe Asn Ser Asp Lys Gly Lys Leu Phe Ser Trp Ala
    210                 215                 220

Phe Asn Tyr Ala Tyr Val Gly Ser Val Phe Leu Leu Phe Cys His Phe
225                 230                 235                 240

Phe Tyr Gln Asp Asn Leu Ala Thr Lys Lys Ser Ala Lys Ala Gly Lys
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Gln Leu


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Met Ala Pro Asp Ala Asp Lys Leu Arg Gln Arg Gln Thr Thr Ala Val
  1               5                  10                  15

gcg aag cac aat gct gct acc ata tcg acg cag gaa cgc ctt tgc agt   96
Ala Lys His Asn Ala Ala Thr Ile Ser Thr Gln Glu Arg Leu Cys Ser
             20                  25                  30

ctg tct tcg ctc aaa ggc gaa gaa gtc tgc atc gac gga atc atc tat   144
Leu Ser Ser Leu Lys Gly Glu Glu Val Cys Ile Asp Gly Ile Ile Tyr
         35                  40                  45

gac ctc caa tca ttc gat cat ccc ggg ggt gaa acg atc aaa atg ttt   192
Asp Leu Gln Ser Phe Asp His Pro Gly Gly Glu Thr Ile Lys Met Phe
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     50                  55                  60

ggt ggc aac gat gtc act gta cag tac aag atg att cac ccg tac cat   240
Gly Gly Asn Asp Val Thr Val Gln Tyr Lys Met Ile His Pro Tyr His
 65                  70                  75                  80

acc gag aag cat ttg gaa aag atg aag cgt gtc ggc aag gtg acg gat   288
Thr Glu Lys His Leu Glu Lys Met Lys Arg Val Gly Lys Val Thr Asp
                 85                  90                  95

ttc gtc tgc gag tac aag ttc gat acc gaa ttt gaa cgc gaa atc aaa   336
Phe Val Cys Glu Tyr Lys Phe Asp Thr Glu Phe Glu Arg Glu Ile Lys
            100                 105                 110

cga gaa gtc ttc aag att gtg cga cga ggc aag gat ttc ggt act ttg   384
Arg Glu Val Phe Lys Ile Val Arg Arg Gly Lys Asp Phe Gly Thr Leu
        115                 120                 125

gga tgg ttc ttc cgt gcg ttt tgc tac att gcc att ttc ttc tac ctg   432
Gly Trp Phe Phe Arg Ala Phe Cys Tyr Ile Ala Ile Phe Phe Tyr Leu
    130                 135                 140

cag tac cat tgg gtc acc acg gga acc tct tgg ctg ctg gcc gtg gcc   480
Gln Tyr His Trp Val Thr Thr Gly Thr Ser Trp Leu Leu Ala Val Ala
145                 150                 155                 160

tac gga atc tcc caa gcg atg att ggc atg aat gtc cag cac gat gcc   528
Tyr Gly Ile Ser Gln Ala Met Ile Gly Met Asn Val Gln His Asp Ala
                165                 170                 175

aac cac ggg gcc acc tcc aag cgt ccc tgg gtc aac gac atg cta ggc   576
Asn His Gly Ala Thr Ser Lys Arg Pro Trp Val Asn Asp Met Leu Gly
            180                 185                 190

ctc ggt gcg gat ttt att ggt ggt tcc aag tgg ctc tgg cag gaa caa   624
Leu Gly Ala Asp Phe Ile Gly Gly Ser Lys Trp Leu Trp Gln Glu Gln
        195                 200                 205

cac tgg acc cac cac gct tac acc aat cac gcc gag atg gat ccc gat   672
His Trp Thr His His Ala Tyr Thr Asn His Ala Glu Met Asp Pro Asp
    210                 215                 220

agc ttt ggt gcc gaa cca atg ctc cta ttc aac gac tat ccc ttg gat   720
Ser Phe Gly Ala Glu Pro Met Leu Leu Phe Asn Asp Tyr Pro Leu Asp
225                 230                 235                 240

cat ccc gct cgt acc tgg cta cat cgc ttt caa gca ttc ttt tac atg   768
His Pro Ala Arg Thr Trp Leu His Arg Phe Gln Ala Phe Phe Tyr Met
                245                 250                 255

ccc gtc ttg gct gga tac tgg ttg tcc gct gtc ttc aat cca caa att   816
Pro Val Leu Ala Gly Tyr Trp Leu Ser Ala Val Phe Asn Pro Gln Ile
            260                 265                 270

ctt gac ctc cag caa cgc ggc gca ctt tcc gtc ggt atc cgt ctc gac   864
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        275                 280                 285
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aac gct ttc att cac tcg cga cgc aag tat gcg gtt ttc tgg cgg gct   912
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    290                 295                 300

gtg tac att gcg gtg aac gtg att gct ccg ttt tac aca aac tcc ggc   960
Val Tyr Ile Ala Val Asn Val Ile Ala Pro Phe Tyr Thr Asn Ser Gly
305                 310                 315                 320

ctc gaa tgg tcc tgg cgt gtc ttt gga aac atc atg ctc atg ggt gtg   1008
Leu Glu Trp Ser Trp Arg Val Phe Gly Asn Ile Met Leu Met Gly Val
                325                 330                 335

gcg gaa tcg ctc gcg ctg gcg gtc ctg ttt tcg ttg tcg cac aat ttc   1056
Ala Glu Ser Leu Ala Leu Ala Val Leu Phe Ser Leu Ser His Asn Phe
            340                 345                 350

gaa tcc gcg gat cgc gat ccg acc gcc cca ctg aaa aag acg gga gaa   1104
Glu Ser Ala Asp Arg Asp Pro Thr Ala Pro Leu Lys Lys Thr Gly Glu
        355                 360                 365

cca gtc gac tgg ttc aag aca cag gtc gaa act tcc tgc act tac ggt   1152
Pro Val Asp Trp Phe Lys Thr Gln Val Glu Thr Ser Cys Thr Tyr Gly
    370                 375                 380

gga ttc ctt tcc ggt tgc ttc acg gga ggt ctc aac ttt cag gtt gaa   1200
Gly Phe Leu Ser Gly Cys Phe Thr Gly Gly Leu Asn Phe Gln Val Glu
385                 390                 395                 400

cac cac ttg ttc cca cgc atg agc agc gct tgg tat ccc tac att gcc   1248
His His Leu Phe Pro Arg Met Ser Ser Ala Trp Tyr Pro Tyr Ile Ala
                405                 410                 415

ccc aag gtc cgc gaa att tgc gcc aaa cac ggc gtc cac tac gcc tac   1296
Pro Lys Val Arg Glu Ile Cys Ala Lys His Gly Val His Tyr Ala Tyr
            420                 425                 430

tac ccg tgg atc cac caa aac ttt ctc tcc acc gtc cgc tac atg cac   1344
Tyr Pro Trp Ile His Gln Asn Phe Leu Ser Thr Val Arg Tyr Met His
        435                 440                 445

gcg gcc ggg acc ggt gcc aac tgg cgc cag atg gcc aga gaa aat ccc   1392
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<213> Phaeodactylum tricornutum

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        35                  40                  45

Asp Leu Gln Ser Phe Asp His Pro Gly Gly Glu Thr Ile Lys Met Phe
    50                  55                  60

Gly Gly Asn Asp Val Thr Val Gln Tyr Lys Met Ile His Pro Tyr His
65                  70                  75                  80

Thr Glu Lys His Leu Glu Lys Met Lys Arg Val Gly Lys Val Thr Asp
                85                  90                  95

Phe Val Cys Glu Tyr Lys Phe Asp Thr Glu Phe Glu Arg Glu Ile Lys
            100                 105                 110

Arg Glu Val Phe Lys Ile Val Arg Arg Gly Lys Asp Phe Gly Thr Leu
        115                 120                 125

Gly Trp Phe Phe Arg Ala Phe Cys Tyr Ile Ala Ile Phe Phe Tyr Leu
    130                 135                 140

Gln Tyr His Trp Val Thr Thr Gly Thr Ser Trp Leu Leu Ala Val Ala
145                 150                 155                 160

Tyr Gly Ile Ser Gln Ala Met Ile Gly Met Asn Val Gln His Asp Ala
                165                 170                 175

Asn His Gly Ala Thr Ser Lys Arg Pro Trp Val Asn Asp Met Leu Gly
            180                 185                 190

Leu Gly Ala Asp Phe Ile Gly Gly Ser Lys Trp Leu Trp Gln Glu Gln
        195                 200                 205

His Trp Thr His His Ala Tyr Thr Asn His Ala Glu Met Asp Pro Asp
    210                 215                 220

Ser Phe Gly Ala Glu Pro Met Leu Leu Phe Asn Asp Tyr Pro Leu Asp
225                 230                 235                 240

His Pro Ala Arg Thr Trp Leu His Arg Phe Gln Ala Phe Phe Tyr Met
                245                 250                 255

Pro Val Leu Ala Gly Tyr Trp Leu Ser Ala Val Phe Asn Pro Gln Ile
            260                 265                 270

Leu Asp Leu Gln Gln Arg Gly Ala Leu Ser Val Gly Ile Arg Leu Asp
        275                 280                 285

Asn Ala Phe Ile His Ser Arg Arg Lys Tyr Ala Val Phe Trp Arg Ala
    290                 295                 300

Val Tyr Ile Ala Val Asn Val Ile Ala Pro Phe Tyr Thr Asn Ser Gly
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305                 310                 315                 320

Leu Glu Trp Ser Trp Arg Val Phe Gly Asn Ile Met Leu Met Gly Val
                325                 330                 335

Ala Glu Ser Leu Ala Leu Ala Val Leu Phe Ser Leu Ser His Asn Phe
            340                 345                 350

Glu Ser Ala Asp Arg Asp Pro Thr Ala Pro Leu Lys Lys Thr Gly Glu
        355                 360                 365

Pro Val Asp Trp Phe Lys Thr Gln Val Glu Thr Ser Cys Thr Tyr Gly
    370                 375                 380

Gly Phe Leu Ser Gly Cys Phe Thr Gly Gly Leu Asn Phe Gln Val Glu
385                 390                 395                 400

His His Leu Phe Pro Arg Met Ser Ser Ala Trp Tyr Pro Tyr Ile Ala
                405                 410                 415

Pro Lys Val Arg Glu Ile Cys Ala Lys His Gly Val His Tyr Ala Tyr
            420                 425                 430

Tyr Pro Trp Ile His Gln Asn Phe Leu Ser Thr Val Arg Tyr Met His
        435                 440                 445

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Leu Thr Gly Arg Ala
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<223> delta-5-desaturase

<400> 7

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  1               5                  10                  15

gga aaa tgg tgt caa att gac gat gct gtc ctg aga tca cat cca ggt   96
Gly Lys Trp Cys Gln Ile Asp Asp Ala Val Leu Arg Ser His Pro Gly
             20                  25                  30

ggt agt gca att act acc tat aaa aat atg gat gcc act acc gta ttc   144
Gly Ser Ala Ile Thr Thr Tyr Lys Asn Met Asp Ala Thr Thr Val Phe
         35                  40                  45

cac aca ttc cat act ggt tct aaa gaa gcg tat caa tgg ctg aca gaa   192
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His Thr Phe His Thr Gly Ser Lys Glu Ala Tyr Gln Trp Leu Thr Glu
     50                  55                  60

ttg aaa aaa gag tgc cct aca caa gaa cca gag atc cca gat att aag   240
Leu Lys Lys Glu Cys Pro Thr Gln Glu Pro Glu Ile Pro Asp Ile Lys
 65                  70                  75                  80

gat gac cca atc aaa gga att gat gat gtg aac atg gga act ttc aat   288
Asp Asp Pro Ile Lys Gly Ile Asp Asp Val Asn Met Gly Thr Phe Asn
                 85                  90                  95

att tct gag aaa cga tct gcc caa ata aat aaa agt ttc act gat cta   336
Ile Ser Glu Lys Arg Ser Ala Gln Ile Asn Lys Ser Phe Thr Asp Leu
            100                 105                 110

cgt atg cga gtt cgt gca gaa gga ctt atg gat gga tct cct ttg ttc   384
Arg Met Arg Val Arg Ala Glu Gly Leu Met Asp Gly Ser Pro Leu Phe
        115                 120                 125

tac att aga aaa att ctt gaa aca atc ttc aca att ctt ttt gca ttc   432
Tyr Ile Arg Lys Ile Leu Glu Thr Ile Phe Thr Ile Leu Phe Ala Phe
    130                 135                 140

tac ctt caa tac cac aca tat tat ctt cca tca gct att cta atg gga   480
Tyr Leu Gln Tyr His Thr Tyr Tyr Leu Pro Ser Ala Ile Leu Met Gly
145                 150                 155                 160

gtt gcg tgg caa caa ttg gga tgg tta atc cat gaa ttc gca cat cat   528
Val Ala Trp Gln Gln Leu Gly Trp Leu Ile His Glu Phe Ala His His
                165                 170                 175

cag ttg ttc aaa aac aga tac tac aat gat ttg gcc agc tat ttc gtt   576
Gln Leu Phe Lys Asn Arg Tyr Tyr Asn Asp Leu Ala Ser Tyr Phe Val
            180                 185                 190

gga aac ttt tta caa gga ttc tca tct ggt ggt tgg aaa gag cag cac   624
Gly Asn Phe Leu Gln Gly Phe Ser Ser Gly Gly Trp Lys Glu Gln His
        195                 200                 205

aat gtg cat cac gca gcc aca aat gtt gtt gga cga gac gga gat ctt   672
Asn Val His His Ala Ala Thr Asn Val Val Gly Arg Asp Gly Asp Leu
    210                 215                 220

gat tta gtc cca ttc tat gct aca gtg gca gaa cat ctc aac aat tat   720
Asp Leu Val Pro Phe Tyr Ala Thr Val Ala Glu His Leu Asn Asn Tyr
225                 230                 235                 240

tct cag gat tca tgg gtt atg act cta ttc aga tgg caa cat gtt cat   768
Ser Gln Asp Ser Trp Val Met Thr Leu Phe Arg Trp Gln His Val His
                245                 250                 255

tgg aca ttc atg tta cca ttc ctc cgt ctc tcg tgg ctt ctt cag tca   816
Trp Thr Phe Met Leu Pro Phe Leu Arg Leu Ser Trp Leu Leu Gln Ser
            260                 265                 270

atc att ttt gtt agt cag atg cca act cat tat tat gac tat tac aga   864
Ile Ile Phe Val Ser Gln Met Pro Thr His Tyr Tyr Asp Tyr Tyr Arg
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        275                 280                 285

aat act gcg att tat gaa cag gtt ggt ctc tct ttg cac tgg gct tgg   912
Asn Thr Ala Ile Tyr Glu Gln Val Gly Leu Ser Leu His Trp Ala Trp
    290                 295                 300

tca ttg ggt caa ttg tat ttc cta ccc gat tgg tca act aga ata atg   960
Ser Leu Gly Gln Leu Tyr Phe Leu Pro Asp Trp Ser Thr Arg Ile Met
305                 310                 315                 320

ttc ttc ctt gtt tct cat ctt gtt gga ggt ttc ctg ctc tct cat gta  1008
Phe Phe Leu Val Ser His Leu Val Gly Gly Phe Leu Leu Ser His Val
                325                 330                 335

gtt act ttc aat cat tat tca gtg gag aag ttt gca ttg agc tcg aac  1056
Val Thr Phe Asn His Tyr Ser Val Glu Lys Phe Ala Leu Ser Ser Asn
            340                 345                 350

atc atg tca aat tac gct tgt ctt caa atc atg acc aca aga aat atg  1104
Ile Met Ser Asn Tyr Ala Cys Leu Gln Ile Met Thr Thr Arg Asn Met
        355                 360                 365

aga cct gga aga ttc att gac tgg ctt tgg gga ggt ctt aac tat cag  1152
Arg Pro Gly Arg Phe Ile Asp Trp Leu Trp Gly Gly Leu Asn Tyr Gln
    370                 375                 380

att gag cac cat ctt ttc cca acg atg cca cga cac aac ttg aac act  1200
Ile Glu His His Leu Phe Pro Thr Met Pro Arg His Asn Leu Asn Thr
385                 390                 395                 400

gtt atg cca ctt gtt aag gag ttt gca gca gca aat ggt tta cca tac  1248
Val Met Pro Leu Val Lys Glu Phe Ala Ala Ala Asn Gly Leu Pro Tyr
                405                 410                 415

atg gtc gac gat tat ttc aca gga ttc tgg ctt gaa att gag caa ttc  1296
Met Val Asp Asp Tyr Phe Thr Gly Phe Trp Leu Glu Ile Glu Gln Phe
            420                 425                 430

cga aat att gca aat gtt gct gct aaa ttg act aaa aag att gcc tag  1344
Arg Asn Ile Ala Asn Val Ala Ala Lys Leu Thr Lys Lys Ile Ala
        435                 440                 445
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Gly Lys Trp Cys Gln Ile Asp Asp Ala Val Leu Arg Ser His Pro Gly
             20                  25                  30

Gly Ser Ala Ile Thr Thr Tyr Lys Asn Met Asp Ala Thr Thr Val Phe
         35                  40                  45
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His Thr Phe His Thr Gly Ser Lys Glu Ala Tyr Gln Trp Leu Thr Glu
     50                  55                  60

Leu Lys Lys Glu Cys Pro Thr Gln Glu Pro Glu Ile Pro Asp Ile Lys
 65                  70                  75                  80

Asp Asp Pro Ile Lys Gly Ile Asp Asp Val Asn Met Gly Thr Phe Asn
                 85                  90                  95

Ile Ser Glu Lys Arg Ser Ala Gln Ile Asn Lys Ser Phe Thr Asp Leu
            100                 105                 110

Arg Met Arg Val Arg Ala Glu Gly Leu Met Asp Gly Ser Pro Leu Phe
        115                 120                 125

Tyr Ile Arg Lys Ile Leu Glu Thr Ile Phe Thr Ile Leu Phe Ala Phe
    130                 135                 140

Tyr Leu Gln Tyr His Thr Tyr Tyr Leu Pro Ser Ala Ile Leu Met Gly
145                 150                 155                 160

Val Ala Trp Gln Gln Leu Gly Trp Leu Ile His Glu Phe Ala His His
                165                 170                 175

Gln Leu Phe Lys Asn Arg Tyr Tyr Asn Asp Leu Ala Ser Tyr Phe Val
            180                 185                 190

Gly Asn Phe Leu Gln Gly Phe Ser Ser Gly Gly Trp Lys Glu Gln His
        195                 200                 205

Asn Val His His Ala Ala Thr Asn Val Val Gly Arg Asp Gly Asp Leu
    210                 215                 220

Asp Leu Val Pro Phe Tyr Ala Thr Val Ala Glu His Leu Asn Asn Tyr
225                 230                 235                 240

Ser Gln Asp Ser Trp Val Met Thr Leu Phe Arg Trp Gln His Val His
                245                 250                 255

Trp Thr Phe Met Leu Pro Phe Leu Arg Leu Ser Trp Leu Leu Gln Ser
            260                 265                 270

Ile Ile Phe Val Ser Gln Met Pro Thr His Tyr Tyr Asp Tyr Tyr Arg
        275                 280                 285

Asn Thr Ala Ile Tyr Glu Gln Val Gly Leu Ser Leu His Trp Ala Trp
    290                 295                 300

Ser Leu Gly Gln Leu Tyr Phe Leu Pro Asp Trp Ser Thr Arg Ile Met
305                 310                 315                 320

Phe Phe Leu Val Ser His Leu Val Gly Gly Phe Leu Leu Ser His Val
                325                 330                 335

Val Thr Phe Asn His Tyr Ser Val Glu Lys Phe Ala Leu Ser Ser Asn
            340                 345                 350
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Ile Met Ser Asn Tyr Ala Cys Leu Gln Ile Met Thr Thr Arg Asn Met
        355                 360                 365

Arg Pro Gly Arg Phe Ile Asp Trp Leu Trp Gly Gly Leu Asn Tyr Gln
    370                 375                 380

Ile Glu His His Leu Phe Pro Thr Met Pro Arg His Asn Leu Asn Thr
385                 390                 395                 400

Val Met Pro Leu Val Lys Glu Phe Ala Ala Ala Asn Gly Leu Pro Tyr
                405                 410                 415

Met Val Asp Asp Tyr Phe Thr Gly Phe Trp Leu Glu Ile Glu Gln Phe
            420                 425                 430

Arg Asn Ile Ala Asn Val Ala Ala Lys Leu Thr Lys Lys Ile Ala
        435                 440                 445


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Met Ala Pro His Ser Ala Asp Thr Ala Gly Leu Val Pro Ser Asp Glu
  1               5                  10                  15

ttg agg cta cga acg tcg aat tca aag ggt ccc gaa caa gag caa act   96
Leu Arg Leu Arg Thr Ser Asn Ser Lys Gly Pro Glu Gln Glu Gln Thr
            20                  25                  30

ttg aag aag tac acc ctt gaa gat gtc agc cgc cac aac acc cca gca   144
Leu Lys Lys Tyr Thr Leu Glu Asp Val Ser Arg His Asn Thr Pro Ala
        35                  40                  45

gat tgt tgg ttg gtg ata tgg ggc aaa gtc tac gat gtc aca agc tgg   192
Asp Cys Trp Leu Val Ile Trp Gly Lys Val Tyr Asp Val Thr Ser Trp
    50                  55                  60
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att ccc aat cat ccg ggg ggc agt ctc atc cac gta aaa gca ggg cag   240
Ile Pro Asn His Pro Gly Gly Ser Leu Ile His Val Lys Ala Gly Gln
 65                  70                  75                  80

gat tcc act cag ctt ttc gat tcc tat cac ccc ctt tat gtc agg aaa   288
Asp Ser Thr Gln Leu Phe Asp Ser Tyr His Pro Leu Tyr Val Arg Lys
                 85                  90                  95

atg ctc gcg aag tac tgt att ggg gaa tka gta ccg tct gct ggt gat   336
Met Leu Ala Lys Tyr Cys Ile Gly Glu Xaa Val Pro Ser Ala Gly Asp
            100                 105                 110

gac aag ttt aag aaa gca act ctg rag tat gca gat gcc gaa aat gaa   384
Asp Lys Phe Lys Lys Ala Thr Leu Xaa Tyr Ala Asp Ala Glu Asn Glu
        115                 120                 125

gat ttc tat ttg gtt gtg aag caa cga gtt gaa tct tat ttc aag agt   432
Asp Phe Tyr Leu Val Val Lys Gln Arg Val Glu Ser Tyr Phe Lys Ser
    130                 135                 140

aac aag ata aac ccc caa att cat cca cat atg atc ctg aag tca ttg   480
Asn Lys Ile Asn Pro Gln Ile His Pro His Met Ile Leu Lys Ser Leu
145                 150                 155                 160

ttc att ctt ggg gga tat ttc gcc agt tac tat tta gcg ttc ttc tgg   528
Phe Ile Leu Gly Gly Tyr Phe Ala Ser Tyr Tyr Leu Ala Phe Phe Trp
                165                 170                 175

tct tca agt gtc ctt gtt tct ttg ttt ttc gca ttg tgg atg ggg ttc   576
Ser Ser Ser Val Leu Val Ser Leu Phe Phe Ala Leu Trp Met Gly Phe
            180                 185                 190

ttc gca gcg gaa gtc ggc gtg tcg att caa cat gat gga aat cat ggt   624
Phe Ala Ala Glu Val Gly Val Ser Ile Gln His Asp Gly Asn His Gly
        195                 200                 205

tca tac act aaa tgg cgt ggc ttt gga tat atc atg gga gcc tcc cta   672
Ser Tyr Thr Lys Trp Arg Gly Phe Gly Tyr Ile Met Gly Ala Ser Leu
    210                 215                 220

gat cta gtc gga gcc agt agc ttc atg tgg aga cag caa cac gtt gtg   720
Asp Leu Val Gly Ala Ser Ser Phe Met Trp Arg Gln Gln His Val Val
225                 230                 235                 240

gga cat cac tcg ttt aca aat gtg gac aac tac gat cct gat att cgt   768
Gly His His Ser Phe Thr Asn Val Asp Asn Tyr Asp Pro Asp Ile Arg
                245                 250                 255

gtg aaa gat cca gat gtc agg agg gtt gcg acc aca caa cca aga caa   816
Val Lys Asp Pro Asp Val Arg Arg Val Ala Thr Thr Gln Pro Arg Gln
            260                 265                 270

tgg tat cat gcg tat cag cat atc tac ctg gca gta tta tat gga act   864
Trp Tyr His Ala Tyr Gln His Ile Tyr Leu Ala Val Leu Tyr Gly Thr
        275                 280                 285

cta gct ctt aag agt att ttt cta gat gat ttc ctt gcg tac ttc aca   912
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Leu Ala Leu Lys Ser Ile Phe Leu Asp Asp Phe Leu Ala Tyr Phe Thr
    290                 295                 300

gga tca att ggc cct gtc aag gtg gcg aaa atg acc ccc ctg gag ttc   960
Gly Ser Ile Gly Pro Val Lys Val Ala Lys Met Thr Pro Leu Glu Phe
305                 310                 315                 320

aac atc ttc ttt cag gga aag ctg cta tat gcg ttc tac atg ttc gtg   1008
Asn Ile Phe Phe Gln Gly Lys Leu Leu Tyr Ala Phe Tyr Met Phe Val
                325                 330                 335

ttg cca tct gtg tac ggt gtt cac tcc gga gga act ttc ttg gca cta   1056
Leu Pro Ser Val Tyr Gly Val His Ser Gly Gly Thr Phe Leu Ala Leu
            340                 345                 350

tat gtg gct tct cag ctc att aca ggt tgg atg tta gct ttt ctt ttt   1104
Tyr Val Ala Ser Gln Leu Ile Thr Gly Trp Met Leu Ala Phe Leu Phe
        355                 360                 365

caa gta gca cat gtc gtg gat gat gtt gca ttt cct aca cca gaa ggt   1152
Gln Val Ala His Val Val Asp Asp Val Ala Phe Pro Thr Pro Glu Gly
    370                 375                 380

ggg aag gtg aag gga gga tgg gct gca atg cag gtt gca aca act acg   1200
Gly Lys Val Lys Gly Gly Trp Ala Ala Met Gln Val Ala Thr Thr Thr
385                 390                 395                 400

gat ttc agt cca cgc tca tgg ttc tgg ggt cat gtc tct gga gga tta   1248
Asp Phe Ser Pro Arg Ser Trp Phe Trp Gly His Val Ser Gly Gly Leu
                405                 410                 415

aac aac caa att gag cat cat ctg ttt cca gga gtg tgc cat gtt cat   1296
Asn Asn Gln Ile Glu His His Leu Phe Pro Gly Val Cys His Val His
            420                 425                 430

tat cca gcc att cag cct att gtc gag aag acg tgc aag gaa ttc gat   1344
Tyr Pro Ala Ile Gln Pro Ile Val Glu Lys Thr Cys Lys Glu Phe Asp
        435                 440                 445

gtg cct tat gta gcc tac cca act ttt tgg act gcg ttg aga gcc cac   1392
Val Pro Tyr Val Ala Tyr Pro Thr Phe Trp Thr Ala Leu Arg Ala His
    450                 455                 460

ttt gcg cat ttg aaa aag gtt gga ttg aca gag ttt cgg ctc gat ggc   1440
Phe Ala His Leu Lys Lys Val Gly Leu Thr Glu Phe Arg Leu Asp Gly
465                 470                 475                 480

tga                                                               1443
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<213> Physcomitrella patens

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<223> Xaa is unknown or other

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<223> Xaa is unknown or other

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Leu Lys Lys Tyr Thr Leu Glu Asp Val Ser Arg His Asn Thr Pro Ala
         35                  40                  45

Asp Cys Trp Leu Val Ile Trp Gly Lys Val Tyr Asp Val Thr Ser Trp
     50                  55                  60

Ile Pro Asn His Pro Gly Gly Ser Leu Ile His Val Lys Ala Gly Gln
 65                  70                  75                  80

Asp Ser Thr Gln Leu Phe Asp Ser Tyr His Pro Leu Tyr Val Arg Lys
                 85                  90                  95

Met Leu Ala Lys Tyr Cys Ile Gly Glu Xaa Val Pro Ser Ala Gly Asp
            100                 105                 110

Asp Lys Phe Lys Lys Ala Thr Leu Xaa Tyr Ala Asp Ala Glu Asn Glu
        115                 120                 125

Asp Phe Tyr Leu Val Val Lys Gln Arg Val Glu Ser Tyr Phe Lys Ser
    130                 135                 140

Asn Lys Ile Asn Pro Gln Ile His Pro His Met Ile Leu Lys Ser Leu
145                 150                 155                 160

Phe Ile Leu Gly Gly Tyr Phe Ala Ser Tyr Tyr Leu Ala Phe Phe Trp
                165                 170                 175

Ser Ser Ser Val Leu Val Ser Leu Phe Phe Ala Leu Trp Met Gly Phe
            180                 185                 190

Phe Ala Ala Glu Val Gly Val Ser Ile Gln His Asp Gly Asn His Gly
        195                 200                 205

Ser Tyr Thr Lys Trp Arg Gly Phe Gly Tyr Ile Met Gly Ala Ser Leu
    210                 215                 220

Asp Leu Val Gly Ala Ser Ser Phe Met Trp Arg Gln Gln His Val Val
225                 230                 235                 240

Gly His His Ser Phe Thr Asn Val Asp Asn Tyr Asp Pro Asp Ile Arg
                245                 250                 255
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Val Lys Asp Pro Asp Val Arg Arg Val Ala Thr Thr Gln Pro Arg Gln
            260                 265                 270

Trp Tyr His Ala Tyr Gln His Ile Tyr Leu Ala Val Leu Tyr Gly Thr
        275                 280                 285

Leu Ala Leu Lys Ser Ile Phe Leu Asp Asp Phe Leu Ala Tyr Phe Thr
    290                 295                 300

Gly Ser Ile Gly Pro Val Lys Val Ala Lys Met Thr Pro Leu Glu Phe
305                 310                 315                 320

Asn Ile Phe Phe Gln Gly Lys Leu Leu Tyr Ala Phe Tyr Met Phe Val
                325                 330                 335

Leu Pro Ser Val Tyr Gly Val His Ser Gly Gly Thr Phe Leu Ala Leu
            340                 345                 350

Tyr Val Ala Ser Gln Leu Ile Thr Gly Trp Met Leu Ala Phe Leu Phe
        355                 360                 365

Gln Val Ala His Val Val Asp Asp Val Ala Phe Pro Thr Pro Glu Gly
    370                 375                 380

Gly Lys Val Lys Gly Gly Trp Ala Ala Met Gln Val Ala Thr Thr Thr
385                 390                 395                 400

Asp Phe Ser Pro Arg Ser Trp Phe Trp Gly His Val Ser Gly Gly Leu
                405                 410                 415

Asn Asn Gln Ile Glu His His Leu Phe Pro Gly Val Cys His Val His
            420                 425                 430

Tyr Pro Ala Ile Gln Pro Ile Val Glu Lys Thr Cys Lys Glu Phe Asp
        435                 440                 445

Val Pro Tyr Val Ala Tyr Pro Thr Phe Trp Thr Ala Leu Arg Ala His
    450                 455                 460

Phe Ala His Leu Lys Lys Val Gly Leu Thr Glu Phe Arg Leu Asp Gly
465                 470                 475                 480
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<210> 12

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<220>
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<210> 13
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<220>
<223> The first 25 amino acid residues of LARS delta-8-desaturase

<400> 13

Met Lys Ser Lys Arg Gln Ala Leu Pro Leu Thr Ile Asp Gly Thr Thr
1 5 10 15

Tyr Asp Val Ser Ala Trp Val Asn Phe
20 25

<210> 14
<211> 25
<212> PRT
<213> Artificial sequence

<220>
<223> The first 25 amino acid residues of delta-8-desaturase described by Wallis & Browse (ABB 1999)

<400> 14

Met Lys Ser Lys Arg Gln Ala Leu Ser Pro Leu Gln Leu Met Glu Gln
1 5 10 15

Thr Tyr Asp Val Ser Ala Trp Val Asn
20 25

<210> 15
<211> 24
<212> PRT
<213> Artificial sequence

<220>
<223> The first 25 amino acid residues of delta-8-desaturase as given in GenBank AAD45877

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Met Lys Ser Lys Arg Gln Ala Leu Ser Pro Leu Gln Leu Met Glu Gln
1 5 10 15

Thr Tyr Asp Val Val Asn Phe His
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<210> 16
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<213> Artificial sequence

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